Technical Report 1262

Evaluation of the Virtual Squad Training System

Donald R. Lampton
U.S. Army Research Institute

Christian J. Jerome
U.S. Army Research Institute

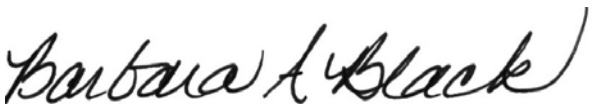
January 2010

United States Army Research Institute
for the Behavioral and Social Sciences

U.S. Army Research Institute
for the Behavioral and Social Sciences

A Directorate of the Department of the Army
Deputy Chief of Staff, G1

Authorized and approved for distribution:



BARBARA A. BLACK, Ph.D.
Research Program Manager
Training and Leader Development Division

MICHELLE SAMS, Ph.D.
Director

Technical review by

Robert Pleban, U.S. Army Research Institute
John S. Barnett, U.S. Army Research Institute

REPORT DOCUMENTATION PAGE

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED (from. . . to)
January 2010	Final	March 2007 – August 2008

4. TITLE AND SUBTITLE	5a. CONTRACT OR GRANT NUMBER
Evaluation of the Virtual Squad Training System	
	5b. PROGRAM ELEMENT NUMBER 622785

6. AUTHOR(S)	5c. PROJECT NUMBER
Donald R. Lampton, and Christian J. Jerome (U.S. Army Research Institute)	A790
	5d. TASK NUMBER 294
	5e. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
U.S. Army Research Institute for the Behavioral and Social Sciences ATTN: DAPE-ARI-IF 12350 Research Parkway Orlando, FL 32826-3276	

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. MONITOR ACRONYM
U.S. Army Research Institute for the Behavioral and Social Sciences 2511 Jefferson Davis Highway Arlington, VA 22202-3926	ARI
	11. MONITOR REPORT NUMBER Technical Report 1262

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

Subject Matter POC: Donald R. Lampton

14. ABSTRACT *(Maximum 200 words)*:

The Virtual Squad Training System (VSTS) is a network of nine individual immersive simulators with Helmet-Mounted Displays (HMDs), and a command station for controlling computer generated entities. The VSTS includes both tethered and wearable simulators. The VSTS was evaluated with two squads (9 members per squad) of Soldiers performing selected individual/fire team tasks and squad tactical exercises for dismounted infantry over a four day period (two days per squad). Soldiers rated the system capabilities of 62 specific simulator functions (such as move and shoot) and rated the perceived training effectiveness for 24 tasks such as react to direct and indirect fire. A structured interview addressed various training issues. Frequent technical problems with individual simulators and the network interfered with the conduct of the evaluation and probably affected Soldiers' ratings of the VSTS. Simulator sickness incidence was low compared to previous evaluations of antecedent systems using HMDs.

15. SUBJECT TERMS

Virtual Environments, Dismounted Infantry, Training, Presence, Simulator Sickness

SECURITY CLASSIFICATION OF			19. LIMITATION OF ABSTRACT	20. NUMBER OF PAGES	21. RESPONSIBLE PERSON
16. REPORT	17. ABSTRACT	18. THIS PAGE			
Unclassified	Unclassified	Unclassified	Unlimited	38	Ellen Kinzer, Technical Publication Specialist, (703) 602-8049

Technical Report 1262

Evaluation of the Virtual Squad Training System

Donald R. Lampton
U.S. Army Research Institute

Christian J. Jerome
U.S. Army Research Institute

ARI – Orlando Research Element
Stephen L. Goldberg, Chief

U.S. Army Research Institute for the Behavioral and Social Sciences
2511 Jefferson Davis Highway, Arlington, VA 22202-3926

January 2010

Army Project Number
622785A790

Personnel, Performance and Training Technology

EVALUATION OF THE VIRTUAL SQUAD TRAINING SYSTEM

EXECUTIVE SUMMARY

Research Requirement:

At the request of TRADOC's Program Integration Office (TPIO) Virtual, National Simulation Center at Ft. Leavenworth, personnel from the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) Orlando Research Unit participated in an evaluation of the Virtual Squad Training System (VSTS) from May 7 to 11 2007. The VSTS is located in the Battle Command Training Center (BCTC), at Schofield Barracks, Hawaii.

The VSTS incorporates nine individual simulators so that each member of a squad can be immersed in a common Virtual Environment (VE). Five of the simulators are freestanding "wearable" simulators using wireless networking. Four are "tethered" with an overhead cable connecting to a computer system. Both types of simulators include Helmet Mounted Displays (HMDs), weapon mockups, and motion control interfaces so that the users (trainees) can move and shoot within the shared VE. The VSTS also includes a BattleMaster station, a Semi-Automated Force (SAF) workstation, a Scenario Authoring station, and an After Action Review station. SAF was used to populate the VE with computer generated opposing forces, friendly and neutral forces, and civilian pedestrians and vehicles. The VE used for this evaluation was a geo-typical database of Northern Baghdad, Iraq.

Procedure:

Two squads of Soldiers performed selected individual/fire team tasks and squad tactical exercises over a four day period (two days per squad). The evaluation plan called for the Soldiers to be assigned to either a tethered or wearable system for the first day, and then switched to the other type of system on the second day.

The morning of their first day of participation, the Soldiers received an orientation briefing, a familiarization session with the system, and structured train-up and practice with the simulators. For the afternoon of the first day and most of the second day the Soldiers conducted squad level exercises in the VE simulators.

The evaluation included the following:

- Background information survey regarding previous relevant training and experience.
- Soldier self-rating of ability to perform 62 basic functions in the simulator.
- Soldier self-rating of the training effectiveness of the VE exercises conducted with the simulator that day.
- Soldier self-rating of symptoms of simulator sickness.

- A structured exit interview that addressed more than a dozen issues ranging from the usability of the individual simulators to the potential training applications of the overall system. Separate interviews were conducted for each squad, and within each squad separate interviews were conducted with the squad leader and two team leaders together and the other squad members together.

Frequent technical problems with the system and some of the individual simulators interfered with conducting the evaluation as planned. More importantly, technical problems undoubtedly influenced almost every aspect of the Soldiers' ratings of the system components, and the system as a whole.

Findings:

Soldier Characteristics

Each squad had nine Soldiers with an appropriate MOS (11 Bravo). Both squad leaders and all the fire team leaders had previous experience at their respective positions in a dismounted infantry squad.

Simulator Sickness

Soldier self-rating of symptoms of simulator sickness included 16 items associated with simulator sickness. The post exposure scores were significantly (in the statistical sense) higher than the pre-exposure baseline scores, but compared to previous research with HMDs the frequency and severity of simulator sickness symptoms were very low. No one withdrew from the evaluation because of simulator sickness. The predominant symptoms were related to eye strain. There were no major problems with nausea or dizziness, which are the symptom categories that are more problematic from a safety perspective.

Simulator Performance Questionnaire

Soldiers completed a questionnaire rating their ability to perform 62 basic functions in the simulator. Examples are: aim weapon, move as an individual, visually locate the source of enemy fire, determine the source of enemy fire by sound, and communicate enemy location to team member. Six of the items had an average rating above "good". Two of these involve movement and four involve use of the weapon. Fifty-two items were rated between "average" and "good". Three items had mean ratings between "average" and "poor." The three lowest rated items were "Determine the source of enemy fire by sound.", "Open gates", and "Open doors". The lack of realistic three dimensional sound was mentioned during the interviews as a system shortfall. However, in the real world location of enemy fire by sound in urban areas is a well known challenge. So in this case the low rating may not represent that big of a problem. In contrast, the low ratings for opening doors and gates do indicate problems that need to be resolved.

Exercise Training Effectiveness

A questionnaire was used to address Soldier self-ratings of the training effectiveness of the exercises conducted with the simulator that day. The Soldiers rated the change, if any, in their ability to perform 24 tasks. Examples are: employ hand grenades, react to direct and indirect fire, and react to a civil disturbance.

The highest rated task was “perform voice communications”. The average rating of .97 falls slightly below “1” the value that corresponds to “slight improvement”. In general these ratings of training effectiveness are low. We believe the ratings are a function of several factors. The scenarios were good; however the exercises and After Action Reviews were greatly hindered by technical difficulties. There is also another critical factor to the ratings. Most of the Soldiers who participated believed that they already knew how to perform these tasks before they took part in this evaluation. Therefore, from their perspective there was little room for improvement.

Interview Comments

A structured interview was used to address more than a dozen different issues. Throughout the interviews, regardless of the specific questions, there were frequent comments that the system was frustrating to use, that the “bugs” should be fixed, and more practice was needed on how to use the system. They made it clear that by more practice they meant additional days, not just a few more hours.

For performance and ease of use the tethered simulator was clearly preferred to the wearable simulator. Better HMD resolution and less lag were cited. The speed and ease of getting in and out of the system was also praised. However, there were two common complaints about the tethered design. The HMD fit on the nose was not good, padding and perhaps an eye cup are needed. Also, the cable seemed “stiff” during turns and was awkward for the tallest users.

The Soldiers liked two aspects of the wearable system. The design of the HMD connection to the helmet was praised as very comfortable. Also, it was easy to turn 360 degrees. There were several complaints about the “leg sensor” (the leg worn body posture tracker). It was difficult to keep adjusted properly.

Several aspects of the VE database were cited as good. The expanse of the database provided room to maneuver. The look of the buildings, and the pervasive people and trash were realistic.

There were several problems cited in controlling movement. It was difficult to move close to or around obstacles inside a building. Their avatar was frequently running when they were trying to walk.

Other problems cited included the static OPFOR and something very wrong in the representation of moving vehicles (approaching vehicles did not make appropriate sounds and occasionally collided with pedestrians). Difficulty seeing distant objects and the lack of peripheral vision were cited. Keeping the visual representation of the weapon “up” was a big problem. Many of the menu functions took too long to perform.

The interviewees felt that if the bugs were fixed the system might be useful for an introduction for new Soldiers and for providing training for small team leaders lacking experience. The system would not be useful for sustainment. The trainees did not believe that the VSTS was suitable for use in the field. If a VE of an operational area were available, it would be very useful for mission rehearsal. It was not clear that they would want to view the terrain model using the HMDs, but a detailed VE would of course be of value.

Finally, the Soldiers' responses when asked for their overall reaction to the VSTS were: "Has potential, but needs a lot of work", "Could be useful if fixed".

Utilization and Dissemination of Findings:

The results were briefed to TPIO in Jun 07. The results can be used in decisions on the development and use of virtual training systems.

Frequent technical problems with the system and some of the individual simulators interfered with conducting the evaluation as planned. More importantly, technical problems undoubtedly influenced almost every aspect of the Soldiers' ratings of the system components, and the system as a whole.

Some of the problems are with the software, some are hardware related, and some are the results of inadequate train-up for the user. Some problems may result from interactions of all three. To the Soldiers trying to conduct exercises with the system the sources of the problems are not clear; however, it is clear that they are frequently frustrated in trying to use the system.

If the system performance is not going to be improved over the level we observed, then the usefulness of the system is in question because training effectiveness would be compromised by the various system problems.

EVALUATION OF THE VIRTUAL SQUAD TRAINING SYSTEM

CONTENTS

LIST OF FIGURES

LIST OF TABLES

EVALUATION OF THE VIRTUAL SQUAD TRAINING SYSTEM

INTRODUCTION

This report describes an evaluation of the Virtual Squad Training System (VSTS) conducted from 7 to 11 May 2007 at Schofield Barracks, HI. The evaluation was lead by TRADOC's Program Integration Office (TPIO) Virtual, National Simulation Center at Ft. Leavenworth, KS. The VSTS is located in the Battle Command Training Center (BCTC), at Schofield Barracks, HI. The evaluation was specifically scheduled to take advantage of the availability of two infantry squads from 2d BCT, 25th ID.

The rest of the report is organized as follows. A brief background section is presented with references to much more highly detailed history of development and use of virtual simulators for dismounted infantry training. The evaluation procedure is described. Results are listed and discussed. A summary and conclusion are presented.

BACKGROUND

Largely as a result of the influence of Gorman (1990), an early proponent of the use of virtual environments (VE) for dismounted infantry (DI) training, the U.S. Army began to be interested in the use of immersive simulation for dismounted Soldier training in the early 1990's. As for other training domains, goals for using simulation for DI training include providing a cost effective, safe, and flexible complement to live training.

The Dismounted Warrior Network (DWN) effort was a U.S. Army Simulation, Training and Instrumentation Command (STRICOM) program to develop a reliable, low-cost, easy-to-use capability to insert dismounted Soldiers into VE. The DWN program (and its successor, DWN Enhancements for Restricted Terrain (ERT)) did not evaluate training effectiveness, but did obtain data, through automated data capture, Soldier questionnaires, and observation, about task performance in the virtual simulators used in the program. Tasks covered movement, orientation, visual recognition, and weapon engagement. Detailed descriptions of these efforts are presented in Lockheed Martin (1997) and Pleban, Dyer, Salter, and Brown (1998).

Following the completion of the DWN experiments, a four-year (FY 1999-2002) Science and Technology Objective (STO) effort was initiated to develop a demonstration virtual dismounted leader trainer at the fire team, squad, and platoon level. Each year of the STO a culminating event (CE) was conducted. The CEs were comprehensive demonstrations and assessments conducted with Soldiers, using as much of the developed technology as was feasible in a realistic training exercise. This body of research is described by Knerr, et al.(2003).

The Virtual –Integrated Military Operations in Urban Terrain (MOUT) Training System (V-IMTS) was a short-term project to speed the transition of the virtual simulation technology

developed under the STO that specifically considered the integration of live and virtual training. The objective of the assessment was to obtain information about the performance of Soldier tasks and training effectiveness in the V-IMTS configuration. The Cassidy Combined Arms Collective Training Center at Ft. Campbell, KY, was the site for the assessment (Knerr & Lampton, 2005).

Throughout this decade of research, the Soldier participants have identified functions they felt were needed to improve the potential training effectiveness of immersive DI training systems. Successive VE systems have incorporated many of these functions, and our data collection instruments have been modified to address these added functions.

METHOD

The VSTS System.

The VSTS is located in the BCTC, at Schofield Barracks, HI. The BCTC is a modern 90,000-square-foot, two-story training center with excellent spatial layout, lighting, acoustics, and temperature control.

The VSTS (described in detail in Appendix A) incorporates nine individual simulators so that each member of a squad can be immersed in a common VE. Five of the simulators are freestanding "wearable" simulators using wireless networking (see Figure 1). Four are "tethered" with an overhead cable connecting to a computer system (see Figure 2). Figure 1 conveys how the nine squad members were co-located during the exercises. Also shown are the weapon mockups for the M4, the M203, and the M249.

Figure 1. Four Soldiers using the wearable simulator.

Figure 2. A Soldier using the tethered simulator.

Both types of simulators include Helmet-Mounted Displays (HMDs), weapon mockups, and motion control interfaces so that the users (trainees) can move and shoot within the shared VE. (During the evaluation the VSTS intra-squad communication was inoperable. However, because all nine simulators were co-located the squad members could communicate by simply yelling at each other.)

The VSTS also includes a BattleMaster station, a Semi-Automated Force (SAF) workstation, a Scenario Authoring station, and an After Action Review (AAR) station. SAF was used to populate the VE with computer generated opposing forces, friendly and neutral forces, and civilian pedestrians and vehicles (see Figure 3). The VE used for this evaluation was a geo-typical database of Northern Baghdad, Iraq.

Figure 3. Screen shot from an exercise. (The avatar "BEC" is controlled by a Soldier in a simulator. The other avatars, including vehicles, are computer controlled entities generated and controlled from SAF station.).

Procedure

Two squads of Soldiers performed selected individual/fire team tasks and squad tactical exercises over a four day period (two days per squad). The evaluation plan called for the Soldiers to be assigned to either a tethered or wearable system for the first day and then switched to the other type of system on the second day. (A detailed description of the planned procedure is in Appendix B. The actual procedure followed is reported below.)

The morning of their first day of participation, the Soldiers received an orientation briefing, a familiarization session with the system, and a structured train-up and practice with the simulators. For the afternoon of the first day and most of the second day the Soldiers conducted squad level exercises in the VE simulators.

Available exercises:

- Break contact
- React to ambush
- Combat Patrol
- Clear a building/room
- Call for and receive QRF support
- Call for MEDIVAC
- Establish a hasty observation point

Numerous technical problems made it impossible to keep track of the actual scenarios that were successfully completed or the amount of time that the Soldiers spent training with those scenarios. As a very rough estimate, we believe that the first squad spent a maximum of 2 hours,

53 minutes in nine scenarios, while squad two spent a maximum of 1 hour, 24 minutes in seven scenarios.

The evaluation included the following:

- Background information survey regarding previous relevant training and experience.
- Soldier self-rating of ability to perform 62 basic functions in the simulator.
- Soldier self-rating of the training effectiveness of the virtual environment exercises conducted with the simulator that day.
- Soldier self-rating of symptoms of simulator sickness.
- A structured exit interview that addressed more than a dozen issues ranging from the usability of the individual simulators to the potential training applications of the overall system. Separate interviews were conducted for each squad, and within each squad separate interviews were conducted with the squad leader and two team leaders together and the other squad members together.

As mentioned above, frequent technical problems with the system and some of the individual simulators interfered with conducting the evaluation as planned. More importantly, technical problems influenced almost every aspect of the Soldiers' ratings of the system components and the system as a whole.

Before the evaluation, an entire day was allocated to finalizing the scenarios; however frequent system crashes interfered with setting up the scenarios and actually testing the scenarios with participants immersed in the individual simulators. Although the scenarios were in general well conceived, the effectiveness of many of the scenarios was compromised because of the inability to make final adjustments such as to the placement of Opposing Forces (OPFOR) and Improvised Explosive Devices (IEDs).

The system experienced several different types of technical problems. The network had frequent crashes. The individual simulators frequently required some adjustment by system support personnel. The individual simulators frequently required a relatively brief and simple recalibration procedure that could be performed by the user. The amount of disruption caused by the self calibration was a function of when it occurred during an exercise. If it was required during the middle of a fire fight then it was highly disruptive, if it was required during a halt it was a negligible inconvenience. Delays in starting the exercises and problems during the exercises were frustrating for the Soldiers participating in the evaluation.

The AAR system was occasionally not available after an exercise, it sometimes crashed during an AAR, and at least once it could not show a critical incident to determine what had happened (a wall occluded identification of which squad member had fired a shot). The research planned called for the VSTS AAR application to be used to capture statistical data such as number of

rounds fired, number of hits, movement routes, movement techniques, communications transmissions, and target identification. However, none of these functions were in evidence during the evaluation.

Additional problems resulted from the illness of one of the two support personnel. For an entire day and part of another the system operator was absent because of illness. Although the other support person did an outstanding job of trying to fill the gap, the absence resulted in additional problems. One example, for the 1st squad the plan to switch the simulator type on the second day proved unworkable. The squad members reverted to the same simulator they used on the first day.

RESULTS AND DISCUSSION

This section is organized as follows: Soldier characteristics, simulator capabilities ratings, training effectiveness ratings, interview responses, and simulator sickness symptoms.

Soldier Characteristics

Each squad had nine Soldiers with an appropriate MOS (11 Bravo). The Soldiers who served as squad leaders and fire team leaders during the VSTS exercises all had previous experience at their respective positions in a dismounted infantry squad. Time in service ranged for 6 to 78 months, with an average of 32 months. (The Soldier background survey is shown in Appendix C).

Simulator Capabilities

At the end of each day Soldiers rated their capability to perform each of 62 functions in the simulator (Appendix D). The rating scale was Excellent = 5, Very Good = 4, Good = 3, Average = 2, Poor = 1, Very Poor = 0. (Because one Soldier was not available at the end of his second day the tables are based on 17, not 18, questionnaires.)

Table 1.
Simulator Capabilities Ratings

Function	Combined	Tethered	Wearable
Move as an individual	3.49	3.5	3.47
Aim weapon.	3.21	3.06	3.33
Move through open areas as a widely separated group.	3.17	3.19	3.16
Fire weapon accurately.	3.17	3.19	3.16
Select fire mode	3.11	3.13	3.11
Scan from side-to-side.	3.11	3.44	2.84
Fire weapon in short bursts.	3.09	3.07	3.11
Scan vertically.	2.97	3.06	2.89
Move close to walls.	2.97	3.13	2.84
Locate assigned areas of observation, e.g. across the street.	2.94	2.88	3
Assume defensive positions.	2.91	3.07	2.79
Take position to one side of the doorway.	2.91	3.29	2.63
Move in single file.	2.89	2.88	2.89
Identify covered and concealed routes.	2.88	3.14	2.68
Move according to directions.	2.86	2.88	2.84
Move quickly to the point of attack.	2.83	2.81	2.84
Locate enemy soldiers inside buildings firing at your unit.	2.77	2.81	2.74
Coordinate with other squad members.	2.77	3.06	2.53
Engage targets within a room.	2.74	2.88	2.63
Identify enemy soldiers.	2.74	2.93	2.58
Execute planned route.	2.71	2.69	2.74
Identify safe and danger areas.	2.71	3	2.47
Maintain position relative to other team/squad members.	2.71	3.13	2.37
Execute the assault as planned.	2.69	2.88	2.53
Identify sector of responsibility.	2.67	2.73	2.61
Identify assigned sectors of observation.	2.66	2.88	2.47
Self awareness of posture	2.65	3.07	2.32
Climb up or down stairs.	2.63	2.88	2.42
Move in tactical formation	2.63	2.94	2.37
Locate support team positions.	2.59	2.64	2.56
Identify areas that mask supporting fires.	2.59	2.69	2.53
Employ tactical hand-held smoke grenades.	2.57	2.78	2.47
Identify non-combatants within a room.	2.56	2.63	2.5
Scan the room quickly for combatants.	2.56	2.69	2.44
Locate fire team buddy positions.	2.56	2.73	2.42
Maneuver close to others.	2.56	2.93	2.26
Maneuver below windows.	2.54	2.43	2.64

Table 2.
Simulator Capabilities Ratings (continued)

Function	Combined	Tethered	Wearable
Maneuver around obstacles.	2.53	2.81	2.28
Identify civilians/non combatants	2.51	2.75	2.32
Take a tactical position while within a room.	2.51	2.75	2.32
Move past furniture in a room.	2.49	2.69	2.32
Look around corners.	2.46	2.5	2.42
Take hasty defensive positions.	2.43	2.5	2.37
Estimate distances from self to a distant object.	2.43	2.5	2.37
Maneuver around corners/PIE.	2.4	2.44	2.37
Use fragmentation grenades.	2.39	2.27	2.47
Communicate SPOT reports to squad leader.	2.39	2.64	2.21
Understand verbal commands.	2.38	2.67	2.16
Communicate enemy location to team member.	2.34	2.38	2.32
Use flash-bang grenades to help clear rooms.	2.33	2.33	2.33
High crawl.	2.31	3.25	2
Move quickly through doorways.	2.29	2.56	2.05
Distinguish between friendly and enemy fire.	2.26	2.19	2.32
Maneuver past other personnel in a room.	2.26	2.44	2.11
Visually locate the source of enemy fire.	2.26	2.63	1.95
Use hand-held illumination (flares).	2.25	2	2.45
Low crawl.	2.24	2.6	2.08
Determine the direction enemy rounds are coming from.	2.21	2.4	2.05
Determine other team/squad members' positions.	2.17	2.63	1.79
Determine the source of enemy fire by sound.	1.86	2	1.74
Open gates	1.5	1.31	1.67
Open doors	1.41	1.31	1.5

N=17

Table 1 presents the average ratings of the ability to perform each of 62 actions in the simulation. The column labeled “combined” lists in descending order the average rating combining both simulator types. The next two columns break down the ratings by simulator type. The average rating for all items was 2.74 for the tethered systems and 2.49 for the wearable. Because the ratings were similar across simulator types the following discussion is based on the combined column.

Six of the items had a rating above 3 “good”. Two of these involve movement and four involve use of the weapon. These findings are consistent with previous research involving similar simulators (Knerr, Garrity, and Lampton, 2004). Fifty-two items were rated between “average” and “good”.

Three items had average ratings between “average” and “poor”. These were “Determine the source of enemy fire by sound.”, “Open gates”, and “Open doors”. The lack of realistic three

dimensional sound was mentioned during the interviews as a system shortfall. However, in the real world location of enemy fire by sound in urban areas is a well known challenge. So in this case the low rating may not represent that big of a problem.

In contrast, the low ratings for opening doors and gates do indicate problems that need to be resolved. Some of the doors in the VE have been modeled such that they can be opened, others cannot. For those that can be opened, it is not clear to the users how to open the doors. This led to very frustrating episodes in which the rest of a fire team was yelling at one team member who was desperately trying to open a door. Either the interface control input or the system train-up need to be improved so that they can open the doors. (Note: the point of this is not to train how to open doors, but tactical considerations of "when" to open doors, and synchronization, during room and building clearing tasks.)

Training Effectiveness Ratings

Table 2 presents in descending order the participants' average individual self-ratings of training effectiveness for a set of tasks highly relevant to dismounted operations in urban environments. The list was prefaced by the statement: "As a result of today's exercises, my ability to perform the following tasks was changed as follows". The rating scale was
No improvement = 0, Slight improvement = 1, Moderate Improvement =2, and Vast Improvement = 3 (see Appendix E).

The highest rated task was "perform voice communications". The average rating of .97 falls slightly below "1", the value that corresponds to "slight improvement". Superficially, this could be thought of as an unexpected outcome in that during this evaluation the intra-squad communication system was inoperable: the squad members simply yelled at each other. (The squad leader did have a hand held radio to communicate with the role player representing the platoon leader.) However, we believe that this reflects that, whatever the limitations or capabilities of the simulation, the scenarios did lead to situations in which the squad members had to communicate with each other, and this practice lead to improvement.

The next to lowest rated item "React to unexploded ordnance hazard" is related to the limited resolution of the HMDs and the lack of pilot testing the scenarios. The Soldiers did not spot the hazard before it exploded. The item with the lowest average rating was "Employ hand grenades". To employ grenades the participant had to cycle thru a list of menu options, select a type of grenade, and then use a power bar approach and the angle of the hand held weapon to determine the trajectory of the grenade.

Table 3.
Perceived Training Effectiveness

Activity	Rating
Perform voice communications	0.97
React to contact	**0.79**
Conduct a combat patrol	0.76
Engage targets during an urban operation	0.74
Move as a member of a fire team	0.74
React to Snipers	0.70
Conduct Tactical Movement in an urban area	0.70
React to direct fire	0.69
Perform movement techniques during an urban operation	0.67
Assault a building	0.66
Move over, through, or around obstacles	0.65
Move under direct fire	0.61
React to indirect fire	0.60
Search a building	0.59
Enter a building during an urban operation	0.58
Engage targets with assigned weapon	0.57
Avoid an Ambush	0.57
Select temporary fighting position	0.53
Break contact	0.42
React to a civil disturbance	0.38
Secure at a halt	0.34
Establish an observation post	0.29
React to unexploded ordnance hazard	0.26
Employ hand grenades	0.24

N = 17

The training effectiveness questionnaire contained 24 unique items. The item "react to indirect fire" inadvertently appeared twice on the printed list, separated by 5 other items. Each occurrence of "react to indirect fire" had the same mean rating, which provides some evidence that the participants were actually reading the items and responding consistently.

In general these ratings of training effectiveness are low. We believe the ratings are a function of several factors. Execution of well designed scenarios was hindered by technical difficulties that affected both the conduct of the exercises and the AAR. During previous research using somewhat similar VE systems at the Soldier Battle Lab at Ft. Benning,GA, and the Cassidy MOUT site at Ft. Campbell, KY, we observed better technical execution of exercises that in turn led to more in-depth AARs (Knerr & Lampton, 2005).

There may be another critical factor that had an impact on the ratings. Many of the Soldiers indicated during the interviews that they already knew how to perform these tasks before they took part in this evaluation.

Interviews

For each question, the interview results for the squad leader and fire team leaders are presented first, then "S-" denotes the comments from the other squad members.

During the two days you were here you used two different types of simulators (tethered and wearable). Did you find you could do some things better in one type of simulator than in the other? If so, what could you do better in the tethered simulator?

- Walk in a straight line.
- Movement was better because the tethered simulator was more responsive and had less lag.
- S - The tethered system was lighter, the visual display was better, the system reacted quicker, and weapon worked better.

What could you do better in the wearable simulator?

- Head movement was easier.
- The wearable simulator provided free range of motion.
- S - The strengths of the wearable system: helmet more comfortable, unrestricted movement, lifelike.

Did you find some things were easier to do in one type of simulator than in the other? If so, what was easier in the tethered simulator?

- In contrast to the wearable system "Didn't need two people to put on the tethered system"

What was easier in the wearable simulator?

- Nothing mentioned

Did you feel more comfortable in one type of simulator than in the other? If so, which

- The HMD for the tethered system is uncomfortable (this was restated several times). It needs padding. It needs an eye cup to avoid distractions. The cable for the tethered system gets "stiff" during turns and needs "slack". The tethered system is more of a problem for very tall users.
- The wearable system is hotter than the tethered system. The leg strap (which held in place a position sensor) on the wearable system was the source of several complaints related to discomfort and problems with walking in a straight line in the Virtual Environment.

- In the wearable the view gets stuck in the "down" position making you look at the ground. To look up, you must keep the weapon up, this in turn leads to arm fatigue.
- Looking up while prone was a problem in both systems.
- The wearable simulator requires too many adjustments, but the wearable head mount is better.
- If the fit of the HMD on the tethered were better, then the tethered would be clearly better. No leg strap, better focus, can stand naturally, just works better. The Army is not about comfort, so even if the HMD fits better on the wearable the tethered is clearly a better choice.

What did you like most about the scenarios?

- Realistic environments: buildings, people, trash, lack of vegetation added to realism.
- Resembled Iraq. Was realistic in the expanse of the virtual environment, not just a MOUT area with two buildings. Freedom to patrol where you wished. Room to maneuver.
- Not physically stressful (this is both good and bad from a training perspective).
- S - The good points of the scenarios: Engage targets, practice reactions to events, identification of people, practice ready-up, lane of fire, practice mind – not body.

What did you like least about the scenarios?

- OPFOR didn't shoot, wouldn't move, just stood there
- About the only ways to interact with suspects was to ignore them or shoot them, that is, they could not detain suspects.
- Insurgents were always dressed the same way
- The simulation of vehicles (traffic) was not good. Hard to identify objects. Can't see people at a distance.
- S - The weak points of the scenarios: not enough enemies to shoot, restricted, unrealistic

What part of the simulation (tasks, conditions, buildings, terrain, etc.) was the most realistic?

- Trash all over was good,
- The environment, variety of buildings, not just a perfect house without function.
- Could actually run in and assault the building.
- Room to travel a great distance using complicated routes

What part of the simulation (tasks, conditions, buildings, terrain, etc.) was the least realistic?

- Should add dogs and little kids.
- Should have sun set or night operations.
- Sound of indirect fire was not realistic.

- When walking on road there is no peripheral vision, so you can pass by a street without recognizing it as a street. You must turn directly and look at it.
- Hand and arm signals take too long. You need to be able to point at stuff, but by the time it works it's too late.
- S - There are no IEDs and no weapon malfunctions.

What was the most difficult task to perform in the simulator?

- Enter and clear a room
- Differentiate team members. (This was addressed for Squad # 2 by having an actual name or nickname appear on each avatar.)
- Voice communications (need for the head sets to work).
- Difficult to maneuver close to objects, negotiate doors, pass by a squad member.
- Difficult to control team and keep track of where team is.
- Hard to keep weapon up (big problem).
- S – Difficult to open and get into doors, difficult to use menu for so many tasks, difficult to determine who is who/who did what

Did you find any aspects of the simulator or simulation distracting?

- How to use properly: need at least an entire day just to learn the system. (This was restated several times.).
- You need to learn self troubleshooting for the simulator.
- Some times when you are close to a wall you can see through the wall.
- You can go through some walls.
- People just show up (teleport).
- Your view changes 45 degrees when your weapon comes up.
- S - the tether, glare on HMD, accidental activation of calibration button on weapon, in wearable: bumping into things and people

Do you think that the simulators you used today were a useful training or sustaining tool (that is, did you learn from today's experience or could it be used to train or sustain combat skills)?

- Not a substitute for physically training in the field
- They already knew how to do lead a team before the virtual exercises
- Made them think
- Has potential, but need to train with it for more than 2 days
- Pretty good set up but needs more realistic movement.
- Should include Stryker and convoy exercises.
- If perfected (without bugs) it could be used to train newer people, but not for sustaining skills for experienced personnel.
- Could walk new people though procedures in a safe environment.

- Would not use after live fire, would be going backwards.
- Good for basic training, but would need four days to be comfortable with the system and the trainees must take it seriously.
- Maybe good for tactical formations and patrols, call for fire, med evacuation, react to ambush, but not for room clearing and not for IED
- Non-combatants: react, take cover, return fire, call higher (radio the Platoon Leader)

What did you learn or how could it be used to train or sustain?

- Trained = Combat patience
- Sustained = movement techniques

Could the simulators used to train non-combat arms Soldiers?

- Could help train drivers, but might give false sense of security to non-combat arms Soldiers

Do you think that this training will affect your performance in a real world setting?

- Resounding "No!" Might help inexperienced trainees if they spent some time in it.
- The situation dictates. It might help in some settings and not in others
- If you have already been there (in combat) won't help
- If you have already been to Iraq two or three times, it will not help.

Where in a unit training program do you think that this type of training would be most appropriate or useful?

- Could help everyone/anyone for reaction to contact.
- Could help inexperienced leaders: LTs, PL SGT, maybe SL
- Lower enlisted personnel, just basic things
- Could be used for introduction for new Soldiers
- Does not replace any other training
- S - Good for basic training, communication training, visual search of threats
- S - This training could improve reactions in the real world and build knowledge on what to do, but might cause someone to think it is just a game: no consequences.
- S - This type of training would be good for crowd control training, new skills, and mission rehearsal.

Under what circumstances or conditions would you use this type of capability in a field environment (for example -- an assembly area to conduct a rehearsal for an actual operation; to train on new skills during training events; to practice unit operations; etc)? ("Never" is an acceptable answer.)

- Could be used for all the examples given above if hadn't been in the field for awhile.

- Could come to the BCTC as a platoon, do squad exercises, then platoon exercise.
- If you have a virtual model of the actual area would help rehearsal and Military Intelligence, would be useful as a high tech sand table.

If you believe the wearable computer simulation has merit for field use, what would have to be changed about the current system to make it more usable in the field environment?

- (Reacted with laughter to this question) Make it waterproof, use it in a trailer not a rucksack approach
- Leg stuff (sensor on the leg) is not good
- Need better sound (directional sound)
- Need commo within the team
- Other: avatars were running (instead of walking) all the time need little bar that says you are tired (as in many game systems), frustrating because you are running (when you want to walk) and not running straight
- S - To use in the field, the system would need to be more durable and rugged.

What is your overall reaction to the VSTS?

- Has potential but needs a lot more work
- When fixed, give users more practice
- Could be used, but should not be relied on
- Could be useful if refined (fixed)

Simulator Sickness

Sickness from simulator exposure was measured using a modified version (see Appendix E) of the Simulator Sickness Questionnaire (SSQ) (Kennedy, Lane, Berbaum, & Lilienthal, 1993). One item was added to differentiate between cold sweating, thought to be related to simulator exposure, and natural warm sweating. Warm sweating is related to normal sweating from physical exertion; ambient room temperature; or type of clothing, harness, or wearable equipment. Since warm sweating is not thought to be related to the negative side effects of the simulator itself, it was not included in the subscale and total severity scoring. Items were rated by participants as either none, slight, moderate, or severe (later scored by the experimenter as 0, 1, 2, and 3 respectively). These raw rating scores were used in the calculations as suggested in Knerr et al. (1998) instead of the weighted scores suggested in Kennedy et al. (1993). Combinations of scored items summarize three distinct symptom clusters, including (a) nausea (stomach awareness, increased salivation, burping), (b) oculomotor (eye strain, headache, blurred vision, difficulty focusing), and (c) disorientation (dizziness, vertigo). The combination of the three symptom clusters summarize the total severity of sickness experienced. Planned paired comparisons were performed for change scores for each of the subscale scores, as well as total severity score. An alpha level of .05 was used for all statistical tests.

Table 3.
Changes in Reported Symptoms as a Result of Simulator Use

All Configurations					
	N	Pre	Post	Change	*p* Value
Total Severity	36	0.49	3.33	2.85	0.00
Nausea	36	0.17	0.67	0.50	0.03
Oculomotor	36	0.24	1.89	1.65	0.00
Disorientation	36	0.08	0.78	0.69	0.02
Wearable					
	N	Pre	Post	Change	*p* Value
Total Severity	20	0.75	2.5	1.75	0.02
Nausea	20	0.25	0.5	0.25	0.33
Oculomotor	20	0.35	1.5	1.15	0.01
Disorientation	20	0.15	0.5	0.35	0.03
Tethered					
	N	Pre	Post	Change	*p* Value
Total Severity	16	0.16	4.38	4.22	0.01
Nausea	16	0.06	0.88	0.81	0.06
Oculomotor	16	0.09	2.38	2.28	0.00
Disorientation	16	0.00	1.13	1.13	0.01

As can be seen in Table 3 above, overall, total severity scores and all sub-scale scores were significantly increased after simulator exposure. Significant increases in nausea were not related to simulator use in the wearable configuration. This could have been due to a number of reasons. Although the tethered system had a higher resolution HMD, it was less comfortable and completely occluded visual stimuli from the real world. Conversely, the wearable configuration was reported by the Soldiers as very comfortable (probably because it was retro-fitted into the combat helmet they are very used to wearing). The wearable HMD did not occlude the real-world peripheral stimuli to the same degree as the tethered system. Visual stimuli from the real-world may have provided motion cues that aided the Soldier in avoiding sickness caused by artificial movement seen solely from a completely immersive HMD. A one-way ANOVA was performed to determine if the post scores were significantly different between the wearable and tethered systems. As Table 4 summarizes, no significant differences were observed.

Table 4.
ANOVA Table of Differences Between Wearable and Tethered Post-Simulation Sickness Scores

		Sum of Squares	df	Mean Square	*F*	*p* Value
Total Severity	Between Groups	31.25	1	31.25	1.83	0.19
	Within Groups	580.75	34	17.08		
	Total	612.00	35			
Nausea	Between Groups	1.25	1	1.25	0.91	0.35
	Within Groups	46.75	34	1.38		
	Total	48.00	35			
Oculomotor	Between Groups	6.81	1	6.81	1.52	0.23
	Within Groups	152.75	34	4.49		
	Total	159.56	35			
Disorientation	Between Groups	3.47	1	3.47	2.42	0.13
	Within Groups	48.75	34	1.43		
	Total	52.22	35			

Table 5.
Changes in Individual Symptoms as a Result of Simulator Use

	N	Pre	Post	Difference	*p* Value
Vertigo	18	0	0	0	
Burping	18	0	0	0	
Salivation Increased	18	0.03	0	-0.03	0.33
Nausea	18	0.06	0.11	0.06	0.43
Difficulty Concentrating	18	0.03	0.08	0.06	0.43
Cold Sweating	18	0.03	0	-0.03	0.33
Dizzy eyes closed	18	0	0.03	0.03	0.33
Stomach aware	18	0	0.06	0.06	0.33
"Full head"	18	0	0.14	0.14	0.24
Dizzy eyes open	18	0	0.17	0.17	0.11
Blurred Vision	18	0	0.11	0.11	0.10
Fatigue	18	0	0.25	0.25	0.06
Headache	18	0.06	0.33	0.28	0.04
General Discomfort	18	0.06	0.36	0.31	0.04
Difficulty Focusing	18	0.03	0.33	0.31	0.04
Eyestrain	18	0.08	0.53	0.44	0.00

Four individual symptoms significantly increased after simulator exposure: general discomfort, headache, difficulty focusing, and eyestrain, which had the largest increase over the other symptoms, as summarized in Table 5 above. Interestingly, these are all oculomotor symptoms

and are considered mild sickness symptoms; the more severe symptoms (e.g., dizzy, vertigo, stomach awareness, burping) had negligible change scores and were non-significant.

One particular simulator station, not type of simulator but a specific simulator station, seemed to be associated with elevated symptom scores. That simulator was flagged for subsequent inspection.

SUMMARY AND CONCLUSIONS

Frequent technical problems with the system and some of the individual simulators interfered with conducting the evaluation as planned. More importantly, technical problems undoubtedly influenced almost every aspect of the Soldiers' ratings of the system components, and the system as a whole.

The self-ratings of the ability to perform 62 actions in the simulator were consistent with previous research involving similar simulators. Six of the items had a rating above 3 "good". Two of these involve movement and four involve use of the weapon. Fifty-two items were rated between "average" and "good". Three items had average ratings between "average" and "poor". These were "Determine the source of enemy fire by sound.", "Open gates", and "Open doors".

The participants' average individual self-ratings of training effectiveness for a set of 24 tasks highly relevant to dismounted operations in urban environments were low. The average for the highest rated task fell slightly below "1" the value that corresponds to "slight improvement".

Interviews identified strengths and weaknesses of the system. Unlike previous research there were few comments about the need to add functions to the system. Rather, the functions that are already there need to work better. Throughout the interview, regardless of the specific questions, there were frequent comments that the system was frustrating to use, that the "bugs" should be fixed, and more practice was needed on how to use the system.

Compared to previous research with HMDs, the frequency and severity of simulator sickness symptoms were very low. No one withdrew from the evaluation because of simulator sickness. The predominant symptoms were related to eye strain. There were no major problems with nausea or dizziness, which are the symptom categories that are more problematic from a safety perspective.

It is unfortunate that the necessary modifications to the network and simulators were not made before the resources of this evaluation were expended. If system performance is not going to be improved over the level we observed, then the usefulness of the system is in question because training effectiveness would be compromised by the various system problems.

.

REFERENCES

Gorman, P. F. (1990). *Supertroop via I-Port: Distributed simulation technology for combat development and training development* (IDA Paper P-2374). Alexandria, VA: Institute for Defense Analysis.

Kennedy, R. S., Lane, N. E., Berbaum, K. S., & Lilienthal, M. G. (1993). A simulator sickness questionnaire (SSQ): A new method for quantifying simulator sickness. International Journal of Aviation Psychology, 3(3), 203-220.

Knerr, B.W., Garrity, P.J., and Lampton, D.R. (2004, December). Embedded training for future force warriors: An assessment of wearable virtual simulators. *Proceedings of the 24th Army Science Conference.* Orlando, FL. (ADA433376)

Knerr, B.W., and Lampton, D.R. (2005). *An Assessment of the Virtual-Integrated MOUT Training System (V-IMTS)* (TR 1163). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (ADA438351)

Knerr, B.W., Lampton, D.R., Singer, M.J., Witmer, B.G., Goldberg, S.L., Parson, K.A. & Parsons, J. (1998). Virtual environments for dismounted Soldier training and performance: Results, recommendations and issues (ARI Technical Report 1089). Alexandria, VA: Army Research Institute. (ADA360109)

Knerr, B.W., Lampton, D.R., Thomas, M., Comer, B.D., Grosse, J.R.., Centric, J., Blankenbeckler, P., Dlubac, M., Wampler, R.L., Siddon, D., Garfield, K., Martin, G.A., & Washburn, D.A. (2003). *Virtual environments for dismounted soldier simulation, training, and mission rehearsal: Results of the FY 2002 culminating event* (ARI Technical Report 1138). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (ADA417360)

Lockheed Martin Information Systems (1997). Dismounted warrior network front-end analysis experiments final report. Orlando, FL: Author.

APPENDIX A: THE VIRTUAL SQUAD TRAINING SYSTEM

VSTS consists of four immersive tethered Soldier systems, five immersive wearable Soldier systems, a BattleMaster station, a Semi-Automated Force (SAF) workstation, a Scenario Authoring station and an After Action Review station. The VSTS weapons mix includes: 5 x M4, 2 x M16/M203 and 2 x M249. VSTS has six terrain databases available for training, including a geo-typical database of Northern Baghdad, Iraq. A tethered system uses a light weight cable to connect to the appropriate computing system and the Soldier's movement is somewhat restricted. A wearable system uses a wireless lightweight durable computer that is attached to the Soldier's back and movement is not restricted.

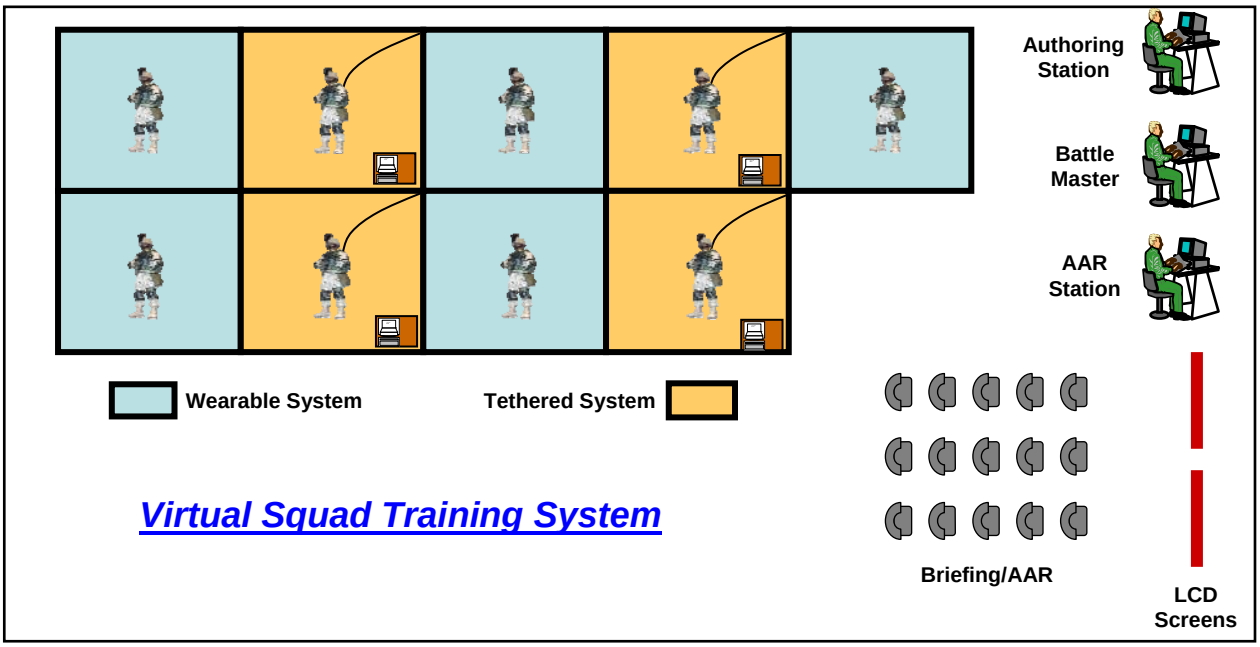


Figure 4 A-1. Virtual squad training system.

APPENDIX B: DAILY SCHEDULES

Each Soldier uses two simulators over a two-day period.

May 8/10 2007

0730	Set-up – All
0800	Soldiers Arrive • Training Assessment Briefing – TPIO Virtual • Symptom Checklist – ARI
0835	Simulator Orientation/Calibration – TPIO Virtual/Instructor Operators (IO) • Suit up/Calibrate • Move and shoot training exercise • Move, shoot & communicate training exercise • Force on Force
1030	Break
1045	React to Sniper (Buddy teams) • Receive plan - (10 minutes) • Move to simulators/calibrate weapons (10 minutes) • Conduct exercise (4 buddy teams) (40 minutes) • AAR (20 minutes) Note: all AARs include administering symptom checklist
1205	Lunch
1330	Identify/react to IED (Squad) • Receive orders and plan - (10 minutes) • Move to simulators/calibrate weapons (10 minutes) • Conduct exercise (20 minutes) • Break (10 minutes) • AAR (20 minutes)
1430	Break Contact (Squad) • Receive orders and plan - (20 minutes) • Move to simulators/calibrate weapons (10 minutes) • Conduct exercise (20 minutes) • Break (10 minutes) • AAR (20 minutes)
1550	Questionnaires & Interviews -- ARI • Symptom Checklist • Simulator Performance Questionnaire
1630	Release Soldiers
1700-U/C	Administrative AAR/Readjust plan

May 9/11 2007

0730 Set-up – All

0830 Soldiers Arrive
- Symptom Checklist -- ARI

0840 Familiarization Exercises
- Move to simulators/calibrate weapons (10 minutes)
- Conduct exercise (20 minutes)
- AAR (10 minutes)

0920 STX React to Ambush (Squad)
- Review plan (10 minutes)
- Move to simulators/calibrate weapons (10 minutes)
- Conduct exercise (20 minutes)
- Break (10 minutes)
- AAR (20 minutes)

1040 Training Exercise – Dismounted Combat Patrol
- Receive orders and plan - (20 minutes)
- Move to simulators/calibrate weapons (10 minutes)
- Conduct exercise (20 minutes)
- Break (10 minutes)
- AAR (20 minutes)

1200 Lunch

1300 Training Exercise – Combat Patrol/Clear a building/room
- Receive orders and plan - (20 minutes)
- Move to simulators/calibrate weapons (10 minutes)
- Conduct exercise (20 minutes)
- Break (10 minutes)
- AAR (20 minutes)

1420 Training Exercise – Combat Patrol/Call for ORF/MEDIVAC
- Receive orders and plan - (20 minutes)
- Move to simulators/calibrate weapons (10 minutes)
- Conduct exercise (20 minutes)
- Break (10 minutes)
- AAR (20 minutes)

1540 Questionnaires & Interviews -- ARI
- Symptom Checklist
- Simulator Performance Questionnaire
- Group Interviews

1630 Release Soldiers

APPENDIX C: BIOGRAPHICAL INFORMATION QUESTIONNAIRE

Soldier's Name_____

Date_____

Please fill in the blank or mark or circle the appropriate response.

1. What is your age? _____ Years

2. MOS _____

3. Rank _____

4. Time in service: Years _____ Months _____

4.a. Combat Experience: Years _____ Months _____ Tours _____

5. What is your current duty position? _____

How long in this position? _____

6. What Army training courses have you completed? Check all that apply.

____ OSUT/AIT _____ PLDC/WLC _____BNCOC

____ Airborne _____ Combat Life Saver Course

____ Air Assault _____ Ranger _____ Other (specify)

7. How susceptible to motion or car sickness do you feel you are?

1	2	3	4	5	6	7
very mildly			average			very highly

8. Do you have normal or corrected to normal 20/20 vision? Yes No

9. Are you color blind? Yes No

10. Are you ___ right handed? ___ left handed?

11. How would you describe your level of confidence in using computers?

1	2	3	4	5
low		average		high

12. How many hours per week do you use computers? _____ hours per week

13. How many hours per week do you play computer or video games (X-Box, Playstation, etc.)? _____ hours per week

14. How often have you trained at a MOUT site since basic training (***NOT*** including demonstrations)?

___ not since basic training ___ 1-3 times ___ more than 3 times

15. Have you ever participated in close quarter combat (room clearing) training or in combat?

Yes No

16. Have you ever participated in a demonstration at a MOUT site?

Yes No

17. Have you ever been in a Virtual simulator before?

Yes No

18. Have you had any <u>other</u> experience with military computer simulations?

Yes No

If yes, please describe briefly or give the names of the simulators.

Simulator Performance Questionnaire

Soldiers Name:_____ Today's Date:_____

Type of simulator: Tethered _____ Wearable _____

Please rate your ability to perform each action in the simulation

	Excellent	Very Good	Good	Average	Poor	Very Poor
1. Move through open areas as a widely separated group.						
2. Move according to directions.						
3. Move as an individual						
4. Move in tactical formation						
5. Maneuver around obstacles.						
6. Move in single file.						
7. Maneuver below windows.						
8. Maneuver close to others.						
9. Determine other team/squad members' positions.						
10. Maintain position relative to other team/squad members.						
11. Maneuver around corners/PIE.						
12. Locate assigned areas of observation, e.g. across the street.						
13. Look around corners.						
14. Visually locate the source of enemy fire.						
15. Determine the source of enemy fire by sound.						
16. Distinguish between friendly and enemy fire.						
17. Identify civilians/non combatants						
18. Communicate enemy location to team member.						
19. Take hasty defensive positions.						
20. Aim weapon.						
21. Fire weapon in short bursts.						
22. Select fire mode						
23. Fire weapon accurately.						
24. Identify covered and concealed routes.						
25. Identify areas that mask supporting fires.						

Simulator Performance Questionnaire (Cont'd):

Please rate your ability to perform each action in the simulation

	Excellent	Very Good	Good	Average	Poor	Very Poor
26. Coordinate with other squad members.						
27. Execute the assault as planned.						
28. Move quickly to the point of attack.						
29. Assume defensive positions.						
30. Identify safe and danger areas.						
31. Locate support team positions.						
32. Locate fire team buddy positions.						
33. Take position to one side of the doorway.						
34. Move quickly through doorways.						
35. Take a tactical position while within a room.						
36. Scan the room quickly for combatants.						
37. Engage targets within a room.						
38. Open doors						
39. Open gates						
40. Identify non-combatants within a room.						
41. Move past furniture in a room.						
42. Maneuver past other personnel in a room.						
43. Understand verbal commands.						
44. Identify sector of responsibility.						
45. Communicate SPOT reports to squad leader.						
46. Execute planned route.						
47. Identify assigned sectors of observation.						
48. Move close to walls.						
49. Scan from side-to-side.						
50. Scan vertically.						
51. Identify enemy soldiers.						
52. Estimate distances from self to a distant object.						
53. Climb up or down stairs.						
54. Locate enemy soldiers inside buildings firing at your unit.						
55. Determine the direction enemy rounds are coming from.						
56. Use fragmentation grenades.						
57. Use hand-held illumination (flares).						
58. Use flash-bang grenades to help clear rooms.						

Simulator Performance Questionnaire (Cont'd):

Please rate your ability to perform each action in the simulation

	Excellent	Very Good	Good	Average	Poor	Very Poor
59. Employ tactical hand-held smoke grenades.						
60. Low crawl.						
61. High crawl.						
62. Self awareness of posture						

Soldier Questionnaire II: Training Effectiveness

ID Number: _____ **Today's Date:** _____

Position Held During Today's Exercise (*Check one*):
_____ **Squad Leader**
_____ **Alpha Team Leader**
_____ **Bravo Team Leader**
_____ **Team Member**

As a result of today's exercises, my ability to perform the following tasks was changed as follows.	No Improve-ment	Slight Improve-ment	Moderate Improve-ment	Vast Improve-ment
Engage targets with assigned weapon				
Employ hand grenades				
Perform voice communications				
Perform movement techniques during an urban operation				
Engage targets during an urban operation				
Enter a building during an urban operation				
Move as a member of a fire team				
Move over, through, or around obstacles				
Move under direct fire				
React to indirect fire				
React to direct fire				
React to unexploded ordnance hazard				
Select temporary fighting position				
React to contact				
Avoid an Ambush				
React to indirect fire				
Break contact				
Secure at a halt				
Conduct a combat patrol				
React to Snipers				
Conduct Tactical Movement in an urban area				
Assault a building				
Search a building				
Establish an observation post				
React to a civil disturbance				

APPENDIX F: SIMULATOR SICKNESS QUESTIONNAIRE

Symptom Checklist

Date_____ **Name_____**

Time_____ **Tethered_____Wearable_____**

Instructions: Please indicate the severity of symptoms that apply to you right now by circling the appropriate word.

1. General discomfort	None	Slight	Moderate	Severe
2. Fatigue (Vest, Weapon)	None	Slight	Moderate	Severe
3. Headache	None	Slight	Moderate	Severe
4. Eye Strain	None	Slight	Moderate	Severe
5. Difficulty focusing (HMD)	None	Slight	Moderate	Severe
6. Salivation increased	None	Slight	Moderate	Severe
7. a. Warm Sweating (from temperature or exertion)	None	Slight	Moderate	Severe
b. Cold Sweating (from discomfort or nervousness)	None	Slight	Moderate	Severe
8. Nausea	None	Slight	Moderate	Severe
9. Difficulty concentrating	None	Slight	Moderate	Severe
10. "Fullness of the Head"	None	Slight	Moderate	Severe
11. Blurred Vision	None	Slight	Moderate	Severe
12. a. Dizziness with eyes open	None	Slight	Moderate	Severe
b. Dizziness with eyes closed	None	Slight	Moderate	Severe
13. Vertigo	None	Slight	Moderate	Severe
14. *Stomach awareness	None	Slight	Moderate	Severe
15. Burping	None	Slight	Moderate	Severe

16. Other (describe): _____

* Stomach awareness is usually used to indicate a feeling of discomfort, which is just short of nausea.